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BLADDER CATHETERIZATION TECHNIQUE FOR MALE RHESUS MONKEYS

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The animals used in this work were handled in accordance with the principles outlined in the *Guide for the Care and Use of Laboratory Animals*, prepared by the Committee on Care and Use of Laboratory Animals of the Institute of Laboratory Animals Resources, National Research Council, DHHS, NIH Publication No. 86-23, 1985; and the Animal Welfare Act of 1966, as amended, 1970 and 1976.

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ABSTRACT

Real-time collection of urine is advantageous in some physiological research. Human bladder catheterization procedures and equipment are not suitable for studies using the rhesus monkey (*Macaca mulatta*) because of anatomical and behavioral differences. We developed a technique for bladder catheterization using a human pediatric naso-gastric feeding tube with a polyethylene extension connected to a fraction collector. The unanesthetized, conditioned animal was seated in a primate restraint chair with neck, arms, and legs restrained. The feeding tube was inserted into the bladder and then secured using a combination of a 10-cc syringe tube, moleskin, Velcro, and tape. Urine collection in a fraction collector during experiments lasting 6 h was accomplished successfully. The catheterization proved reliable with no evidence of irritation or other sequelae.

INTRODUCTION

Determination of urine production, concentration, and composition is important in many physiological studies such as those concerned with thermoregulation, exercise, and pharmaceutical research (1-3). The rhesus monkey (*Macaca mulatta*) is often used as a model for physiological research, but bladder catheterization is difficult due to the size of the urethra and uncooperativeness of the animal. Several studies have reported using infant feeding tubes for urine collection in primates (4-7). We developed a technique for catheterizing male rhesus monkeys using a human pediatric naso-gastric feeding tube. This procedure has been used to successfully collect urine from chair-restrained monkeys in an environmental chamber during experiments lasting up to 6 h.

METHOD

A total of 10 different male rhesus monkeys were used in the study. The animals varied in weight from 4 to 9 kg. At least two people were required for this procedure: one person maintained sterile technique, while the other person assisted. Using the pole-and-collar method (Primate Products, Redwood City, CA), a monkey was captured and seated in a standard primate restraint chair (Primate Products, Redwood City, CA). The catheters used were either a size seven or eight French naso-gastric feeding tube (Medivations, Inc., Wauwatosa, WI), 41 cm long, usually used in human infants. With the larger monkeys (7-9 kg), the size of the urethra required a number eight French tube to reduce the possibility of the tube doubling over.

With the monkey unanesthetized, the pubic area was thoroughly scrubbed with betadine and then wiped with 70% isopropyl alcohol. Sterile xylocaine gel was applied to the tip of the penis. Using sterile gauze, the end of the penis was held while inserting the catheter. Prior to inserting the catheter, it was filled with 2% xylocaine solution with the tip lubricated with sterile xylocaine gel. While the catheter was being inserted, the 2% solution was slowly infused. When the catheter reached the sphincter muscle of the bladder, an increase in resistance was sensed. We found that by maintaining a slight, constant pressure on the catheter against the sphincter muscle of the bladder while injecting the xylocaine solution, the muscle relaxed enough to allow the catheter to enter the bladder (after approximately 1-3 min).

After the catheter was inserted into the bladder, the 2% xylocaine-filled syringe was removed from the external end of the catheter and urine flow verified. If flow was not present, a few milliliters of saline were injected through the catheter. If the catheter was properly inserted, saline return was immediately observed through the catheter. If the catheter was either doubled over or had not penetrated the sphincter muscle, the saline return was around the outside of the catheter, back through the urethra, and out the end of the penis. In these instances, the catheter was withdrawn and discarded and catheterization with a new sterile feeding tube was attempted.

To secure the catheter for experimental use, we used a 10-cc syringe with the plunger removed and the hub end cut off (to form a tube open at both ends) to support the catheter. With the flared plunger end toward the animal the catheter was guided through the syringe barrel. The syringe barrel was held in place against the animal, and the open end was taped closed while holding the catheter in place. The syringe was supported by a combination of moleskin, Velcro and tape as shown in Fig. 1. The moleskin (with the backing retained on the adhesive side) was cut in the outline shown in the figure. Next, the moleskin was cut in the center just enough for a syringe to fit through. If this cut was too large, the syringe was not properly supported. One strip of Velcro (hook type) was stapled to the top and one to the bottom of the moleskin, facing outward. The moleskin was carefully pushed over the syringe and catheter to the monkey's body while supporting the syringe so that the catheter was not pulled out of the bladder. When the moleskin was pushed as far as it would go over the syringe, tape was applied at the moleskin-syringe interface.

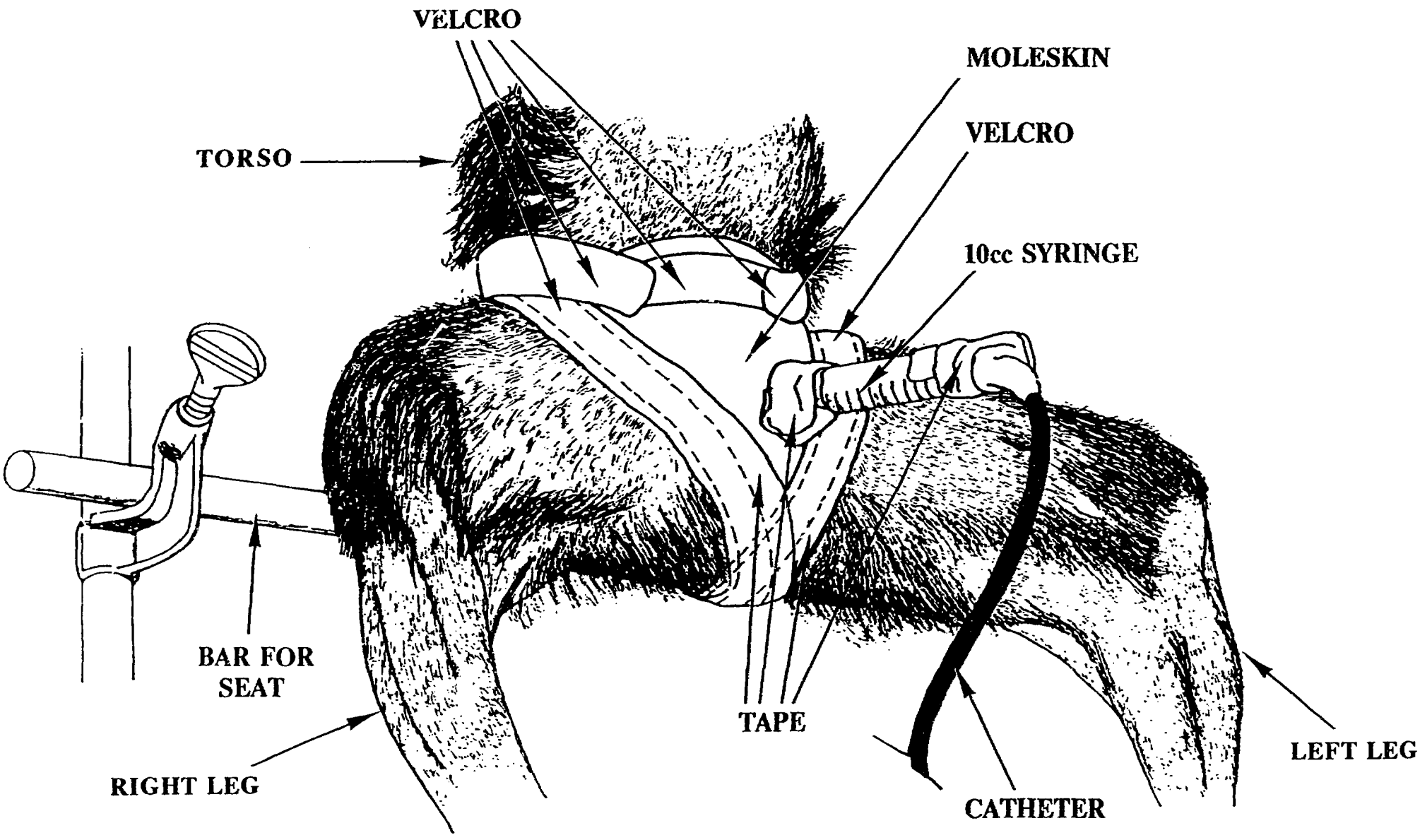

Figure 1. Bladder catheter configuration for urine collection in male rhesus monkey.

The moleskin was held in place by two strips of 1.90-cm wide Velcro (ring type). One strip was cut long enough to go around the animal's lower torso. The other strip was cut so that it would go around the animal's legs, across the inguinal area twice (this strip was split lengthwise except for approximately 1 inch at one of the ends). The waist strip was wrapped around the animal's lower torso with each end attached to the Velcro on the top of the moleskin. The solid end of the other split strip was connected to the bottom Velcro on the moleskin. Each end was wrapped around the animal's legs with the strips crossing over in the middle, near the subpubic area of the groin. Finally, a layer of tape was placed over the Velcro leg straps to help hold the moleskin in place.

A 45-cm extension of polypropylene tubing was used to connect the catheter to the fraction collector for unattended urine collection. The time interval of urine collection was dependent only on the size of the collection tube used in the fraction collector.

DISCUSSION

The method for urine collection described above has been used successfully in both juvenile and adult male rhesus monkeys. We have had very few instances when this procedure caused irritation or problems either during the insertion or the 6-h experimental session. The only problem encountered occurred on rare occasions during the catheterization procedure when the tube would double over on reaching the sphincter muscle during insertion. In two different animals, about 3 cm of the tip of the catheter folded over due to either too much resistance at the sphincter muscle or to an anatomical abnormality. One of the animals required minor surgery to remove the folded catheter. That monkey was catheterized successfully numerous times before he attained approximately 7 kg body weight. Apparently, an anatomical change caused the catheter to double over at the sphincter muscle on two different attempts. Both aborted attempts required minor surgery to remove the catheter. When the catheter doubled over in the other animal, it was easily removed (without surgery), and another catheter was inserted immediately without incidence. This problem was effectively reduced by injecting the 2% xylocaine solution through the catheter to anesthetize and relax the sphincter muscle and waiting longer for it to take effect before continuing the constant pushing pressure on the tube against the sphincter. In a few instances, we observed a small amount of blood in the urine collected. This was possibly caused by the movements of animals, which were active in the restraint chair, presumably causing the tip of the catheter to rub against the inside of the bladder. This was alleviated by increasing the amount of restraint chair training before catheterizations.

The bladder catheterization procedure described here afforded reliable urine collection during experiments with rhesus monkeys in cold physiology research. We were able to accurately measure urine volume during six-hour experiments on restrained, unanesthetized monkeys. This unique catheterization technique also permitted the analysis of the concentration of solutes in the urine produced. In the past 2 years, over 50 separate experimental sessions have been completed successfully with this method of urine collection with each animal being catheterized numerous times.

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